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Pelagic Permian Conodonts from an Oceanic Sequence at Sang-e-Sefid (Fariman, NE-Iran)

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With 4 Text-Figures and 2 Plates

NE-Iran
Fariman
Lower Permian
Ophiolites
Pelagic conodonts

Contents

Zusammenfassung

Eine Gesteinsprobe, die von A. W. RUTTNER einem schwach metamorphen Komplex bestehend aus Pillow-Laven, Spiliten, ultramafischen Gesteinen, Schiefern, feinsandigen Turbiditen, Radiolariten und Kalkblöcken entnommen wurde, lieferte pelagische Conodonten des höchsten Unter-Perms. Die Conodoten wurden aus einem rötlich gefärbten Kieselschiefer mittels Flußsäure herausgelöst. Ihr Erhaltungszustand ist schlecht (CAI = 6), aber einige Formen waren bestimmbar. Die in stratigrahischer Hinsicht wichtigsten Arten sind: *Mesogondolella gujioensis* (IGO), *M. shindyensis* KOZUR, n. sp. (Holotypus aus dem Oberen Jachtashian des Pamirs), *Pseudohindeodus nassichuki* (KOZUR, 1976) und *Hindeodus excavatus* (BEHNKEN, 1975). Sie sind bezeichnend für oberstes Jachtashian (oberstes Kungurian) bis unteres Chihsian (oberstes Unter-Perm). Die bestimmbaren Conodonten sind typische Vertreter sowohl der pelagischen zirkumpazifischen Perm-Fauna wie der pelagischen Tethys-Fauna des Perm.

Abstract

A rock sample collected by A. W. RUTTNER east of Sang-e-Sefid (Fariman-area, SE of Mashhad, NE-Iran) in an assemblage of slightly metamorphosed pillow lavas, spilites, ultramafics, slates, fine sandy turbidites, radiolarites and limestone blocks yielded pelagic conodonts of highest Lower Permian age.

The conodonts have been solved by HF from a reddish chert. Their preservation is bad (CAI = 6), but some forms are determinable. Stratigraphically most important are *Mesogondolella gujioensis* (IGO), *M. shindyensis* KOZUR, n. sp. (holotype from the Upper Jachtashian of Pamirs), *Pseudohindeodus nassichuki* (KOZUR, 1976) and *Hindeodus excavatus* (BEHNKEN, 1975). They indicate uppermost Jachtashian (topmost Kungurian) to Lower Chihsian age (highest Lower Permian). The determinable conodonts are typical representatives of the Circum-Pacific and Tethyan pelagic Permian faunas.

Preliminary Note of the Editor

(A.W. RUTTNER)

In the course of a geological mapping campaign carried out in the area of Fariman, i. e. to the southeast of the town of Mashhad and about 50 kilometers southwest of Aghdarband, a team of the Geological Survey of Iran found out that rocks shown on the NIOC-map of Iran (1978) in the area northeast of the Fariman–Torbat-e-Jam depression as "slates, schists, metamorphic undiff." are in fact remains of an old ocean floor being the southeastern continuation of a zone of ophiolitic

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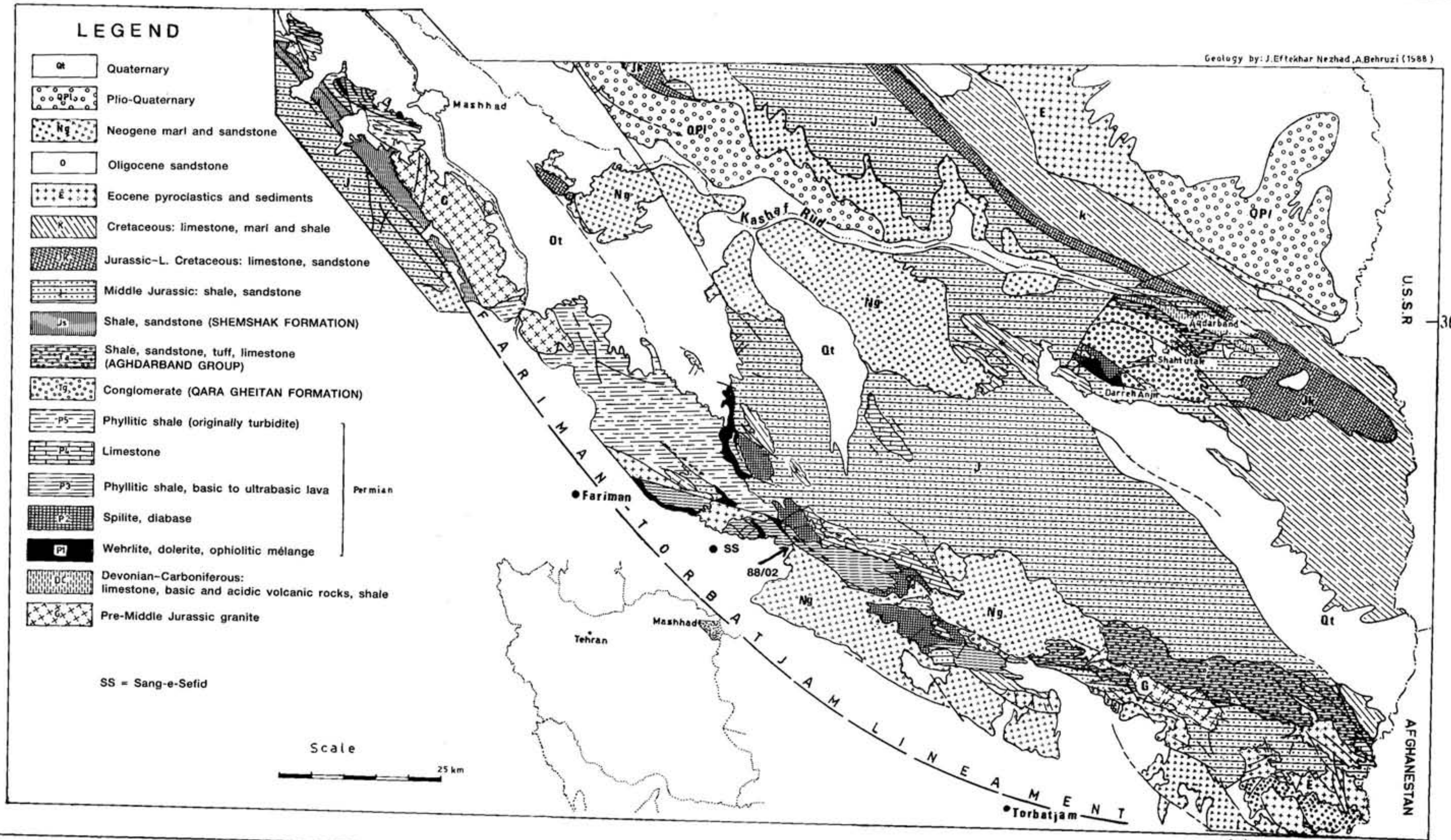
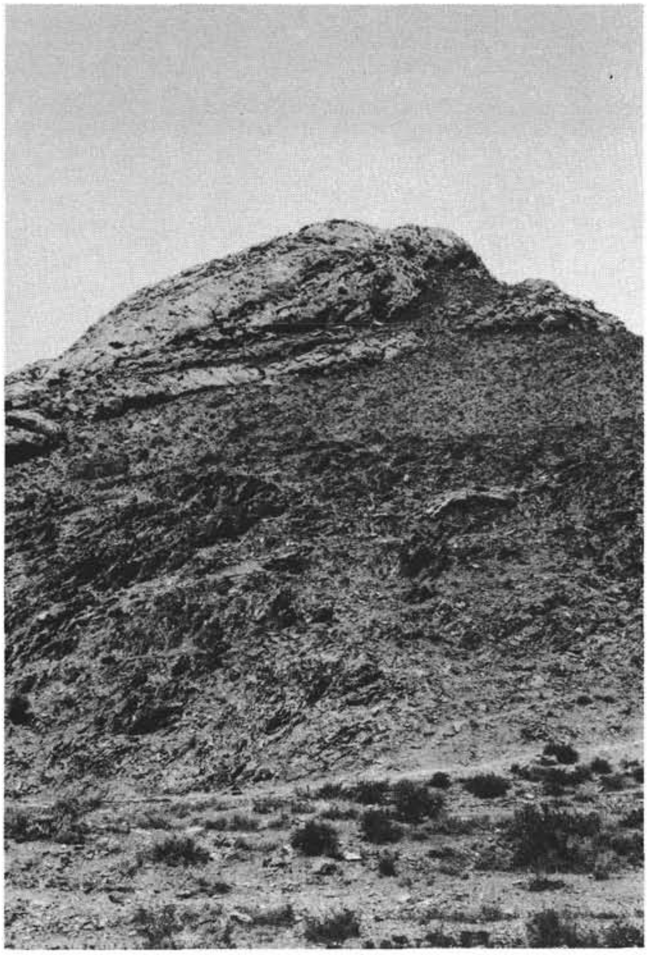


Text-Fig. 1.
Preliminary Geological Map of NE Khorasan.
After J. EFTEKHARNEZHAD & A. BEHROOZI (same volume).



Text-Fig. 2.
Isolated block of limestone, imbedded in siltstone and slate.
ENE Sang-e-sefid.
Photo: A.W. RUTTNER.

rocks already known from the area west of Mashhad (MAJIDI, 1981). J. EFTEKHARNEZHAD and A. BEHROOZI report on these new findings in this volume and distinguish this zone into two complexes: into a lower one consisting of

"... submarine basic and ultrabasic volcanics with intercalations of fine clastic rocks, carbonates, radiolarite and radiolarian red shale",

and into an upper one which is dominated by

"... fine clastic sediments and phyllitic shale ... (with a few intercalations of basic spilite and recrystallized limestone)".

The preliminary geological map of NE-Khorasan compiled by these two authors (Fig. 1) shows the extension and the lithological composition of this ophiolitic zone.

The pre-Jurassic age of the ophiolitic rock assemblage is proved by its unconformable contact with the covering Kashaf Rud Formation. A microfauna found in sparry limestone of the lower complex is classified by F. BOZORGNIA (in: EFTEKHARNEZHAD & BEHROOZI, this vol.) to be Early Permian in age. This limestone forms large blocks which are foreign bodies in this pelagic environment (Fig. 2); it may be also a turbidity calcarenite intercalated in the pelagic rocks (Fig. 3). The age of the pelagic components themselves was not known until very recently.

The undersigned collected a few samples of red chert on the occasion of a visit of the area in 1988 under the guidance of J. EFTEKHARNEZHAD and A. BEHROOZI, hoping that radiolarians may provide a clue to the age of these pelagic sedimentary rocks. But, unfortunately, an examination at the Geological Department of the University of Innsbruck proved the lack of determinable radiolarians in these samples.

Now, this volume being just ready for the press, one of the samples – a reddish chert – yielded conodonts which permit, though badly preserved, an exact time classification. The sample is collected at the road to Garmab, 12 kilometers to the East of the village Sang-e-Sefid and 35 kilometers east of Fariman respectively (see Fig. 1); the outcrop is shown in detail in Fig. 4.

The undersigned is indebted to the authors of this paper for their speedy cooperation!

1. Introduction

Paleomagnetic data indicate the existence of wide oceanic areas between Gondwana and Asia during the Permian. The same is indicated by the presence of Permian (Asselian to Changxingian) pelagic Circum-

Text-Fig. 3.
Echinodermal calc-arenite showing graded bedding, intercalated between slates + turbidites (right) and diabase (left).
The sequence is overturned.
Tangel-e-Robat, W Sang-e-Sefid.
Photo: A.W. RUTTNER.

Radiolarian chert (r) between diabase (d).
NE Sang-e-Sefid, road to Garmab (site where sample No. P88/2 was collected).
Photo: A.W. RUTTNER.

Pacific condonts and Circum-Pacific Middle Permian radiolarians from Crete, Greece (KOZUR & KRAHL, 1987) and Permian (Kungurian to lowermost Changxingian) pelagic Circum-Pacific faunas (conodonts, radiolarians, ammonoids etc.) from Western Sicily, Italy (CATALANO; DI STEFANO & KOZUR, 1988a,b). However, so far only Upper Permian (Dzhulfian, Changxingian) pelagic faunas are known from Iran, e.g. from Abadeh (Central Iran) and from Julfa (Transcaucasia, NW Iran, see TARAZ (1969, 1971, 1973, 1974; Iranian-Japanese Research Group, 1981; STEPANOV et al., 1969; TEICHERT, KUMMEL & SWEET, 1973; KOZUR, MOSTLER & RAHIMI-YAZD, 1975.

The conodont fauna of the Fariman area south of the Aghdarband window is the first pelagic Lower Permian conodont fauna from Iran. It derives from a reddish chert in a slightly metamorphosed ophiolitic sequence of pillow basalts, splites, ultramafics and slates, partly with sandy and cherty intercalations and some limestone blocks. The so far known Lower Permian faunas of Iran are exclusively shallow water faunas with fusulinids.

2. Paleontological Part

The conodonts have been solved by HF from reddish cherts. Their preservation is bad, the metamorphic alteration is high (CAI = 6, 360–550°C). Many conodonts disintegrated into small pieces by shearing processes. However, the cracks are often closed by secondary mineralization. Therefore even from specimens, sheared into small pieces, complete exemplares or large determinable pieces could be found.

Most frequent is the genus *Pseudohindeodus* GULLO & KOZUR, 1990. The genera *Hindeodus* REXROAD & FURNISH, 1964 and *Mesogondolella* KOZUR, 1988 are frequent as well. The gondolellid conodonts are dominated by *Mesogondolella shindyensis* KOZUR n. sp. first figured by KOZUR (1978) from the Pamirs. Because the description of this species will appear later than the present paper, it is here described to avoid nomina nuda.

Genus *Mesogondolella* KOZUR, 1988

Type species: *Gondolella bisselli* CLARK & BEHNKEN, 1971

Description of the genus: see KOZUR (1989).

Mesogondolella shindyensis KOZUR, n. sp.

(Pl. 1, Figs. 1,2,5,6,8)

Derivatio nominis: According to the occurrence at the river Shindy, Pamirs.

Holotype: The specimen figured by KOZUR (1978) on Pl. IV, Figs. 15a,b, rep.-no. 1977 I-2.

Locus typicus: Section at the river Shindy (Pamirs) described by LEVEN (1967).

Stratum typicum: Pelagic limestones of uppermost Jachtashian age near the Jachtashian (Kungurian)/ Chihsian boundary.

Material: More than 100 specimens.

Diagnosis: Platform element medium-sized. Posterior end roundish-pointed or obliquely rounded. Platform widest somewhat behind the midlength. Carina in adult forms with 11–12 denticles of roundish cross section. Also in the anterior part the denticles are not fused. Main cusp terminal, indistinct. Platform surface pitted, only a narrow strip along the carina is smooth. Platform margins only slightly elevated. On lateral view the platform is only slightly arched.

Lower surface with shallow V-shaped keel and terminal basal cavity.

Maximum length: 900 µm

Maximum width: 290 µm.

Distribution: Upper Jachtashian to Lower Chihsian. Pamir, Fariman (Iran).

Remarks: *Mesogondolella bisselli* CLARK & BEHNKEN, 1971 is larger (adult specimens always more than 1000 µm), has a rounded to square posterior margin and generally more denticles (12–15).

Mesogondolella intermedia (IGO, 1981) has similar size and platform outline, but with broadly rounded posterior end. However, the denticles are moderately fused in the anterior part of the carina.

Mesogondolella gujioensis (IGO, 1981) has a similar posterior end of the platform, but the platform outline is different and the denticles of the carina are in their lower part fused in adult specimens.

The present material from Fariman area is badly preserved, but the main features of the species are well recognizable, even in broken specimens.

Mesogondolella gujioensis (IGO, 1981)

(Pl. 1, Figs. 11,12)

Neogondolella gujioensis IGO, n. sp. – IGO, 1981, P. 37–38, Pl. 3, Figs. 1–19; Pl. 4, Figs. 1–6.

Distribution: Upper Jachtashian (Kungurian) of Japan, Chihsian of Japan and Sicily.

Remarks: Only some juvenile forms of this specis are known that are well comparable with juvenile forms of *M. gujioensis* (IGO, 1981).

Mesogondolella sp.

(Pl. 2, Fig. 10)

Remarks: Only a fragment of the anterior part of the platform is present. The denticles are slightly fused. This specimen is not determinable in species level. However, the low fused carina indicate a representative of the *Mesogondolella intermedia* group.

Genus *Hindeodus* REXROAD & FURNISH, 1964

Type species: *Hindeodus cristulus* (YOUNGQUIST & MILLER).

Hindeodus excavatus (BEHNKEN, 1975)

(Pl. 1, Figs. 10,13; Pl. 2, Fig. 6)

1975 *Ellisonia excavata* n. sp. – BEHNKEN, p. 302–303, Pl. 1, Figs. 9–14.

1975 *Anchignathodus minutus* (ELLISON, 1941) – BEHNKEN, p. 297, Pl. 1, Figs. 16, 17, non! Fig. 18.

1984 *Hindeodus excavatus* (BEHNKEN) – WARDLAW & COLLINSON, p. 268–269, Pl. 5, Figs. 2, 4–9, non! Fig. 1.

Remarks: This species has been revised by GULLO & KOZUR (1990, in press) and restricted to forms, in which the spathognathodiform element displays a gradual lowering of the blade. Such specimens are also present in our material.

Distribution: Higher Lower Permian to Middle Permian. Worldwide.

Genus *Pseudohindeodus* GULLO & KOZUR, 1990

Type species: *Pseudohindeodus ramovsi* GULLO & KOZUR, 1990.

Pseudohindeodus nassichuki (KOZUR, 1976)

(Pl. 1, Figs. 3,4,7,9; Pl. 2, Fig. 2)

1976 *Diplognathodus nassichuki* KOZUR, n. sp. – KOZUR & MOSTLER, p. 2–3, Pl. 1, Figs. 15–18.

Distribution: Chihsian of Pamirs. Upper Jachtashian and Lower Chihsian of Fariman, Iran.

Remarks: Most characteristic for the genus *Pseudohindeodus* GULLO & KOZUR, 1990 is the very broad cup on the extremely excavated basal cavity. The cup is asymmetrical, widest somewhat before the midlength and has a submarginal ridge. In our badly preserved material the ridge is not well visible (only on the specimen on Pl. 1, Fig. 4), but the very broad asymmetrical cup is even recognizable in this badly preserved material.

Pseudohindeodus ? catalanoi GULLO & KOZUR, 1990

(Pl. 2, Fig. 1)

Remarks: This very badly preserved form has seemingly a distinct anterior bar, characteristical for *P. ? catalanoi* GULLO & KOZUR, 1990. However, because only one specimen is present, an exact determination of this species, so far only known from the Wordian of Sicily, is not possible.

Pseudohindeodus sp.

(Pl. 2, Fig. 5,7,8)

Remarks: Many broken specimens are known that belong surely (Pl. 2, Fig. 5) or most probably to *Pseudohindeodus*. A specific determination is not possible. Also the indeterminable very fragmentary condonts, figured on Pl. 2, Figs. 9, 11 may belong to *Pseudohindeodus*.

3. Conclusions

The rather primitive *Mesogondolella shindyensis* KOZUR, n. sp., in which the denticles in adult specimens are separated along the whole carina, indicate a Late Jachtashian (Late Kungurian) age. In the Chihsian and younger beds, adult gondolellids have always fused dentlicles at least in the anterior part of the carina.

A highest Lower Permian age is also indicated by *Mesogondolella gujioensis* (IGO, 1981) that occurs in Japan from the Jachtashian up to the Chihsian.

Pseudohindeodus nassichuki (KOZUR, 1976) occurs in the Pamirs in Late Jachtashian and Chihsian ammonoid-bearing beds.

Hindeodus excavatus (BEHNKEN, 1975) is a long-ranging species that occurred at least from the Jachtashian (Kungurian) up to the basal Late Permian (Abadehian).

As a whole, the conodont fauna indicate Late Jachtashian (Late Kungurian) age. Only *Pseudohindeodus ? catalanoi* GULLO & KOZUR, 1990 could indicate somewhat younger (Wordian) age. However, the determination of the only present badly preserved specimen is not sure.

The association with *Mesogondolella, Pseudohindeodus* and some *Hindeodus* without *Neostreptognathodus* and *Stepanovites* is in the higher Lower Permian quite characteristical for pelagic deep water sediments (e. g. radiolarites from Japan, deep-water radiolarian-bearing siliceous limestones of Western Sicily).

The first evidence of pelagic Lower Permian condonts in the Fariman area (northern Iran) is paleogeographically very important. These conodonts derive from the lower part of a sequence that contains pillow diabases, spilites, gabbros, ultramafics, turbidites and phyllitic slates with sandy and cherty intercalations.

In dependence from the age of the upper unit, not investigated by the present authors, two possible explanations can be given:

1) If the upper unit displays Triassic age, then the oceanic sequence of the Fariman area belongs to the Cimmerian Ocean sensu KOZUR (1990) = Paleotethys sensu SENGÖR (1984). As pointed out by KOZUR (1990) this northern (Cimmerian) Tethys opened from E to W later and later: In Western Turkey during the Dzhulfian (KAYA & KOZUR, in prep.), in the Stranža Mts. (Bulgaria) during the Early Scythian, in the Transylvanian oceanic sequence (Eastern Carpathians, Romania) during the latest Scythian and in the Meliata-Hallstatt segment (Western Carpathians – Eastern Alps) of this ocean during the Middle Anisian.
   East of Turkey we have to await in continuation of this trend a pre-Dzhulfian opening of the Cimmerian Tethys. A Lower Permian opening of the Cimmerian Tethys in the Fariman area would be therefore in agreement with the general trend of E–W prograding opening of this ocean.
   The Cimmerian Tethys was partly closed during the latest Triassic (Karakaya complex of Western Turkey), partly during the Lower Oxfordian (KOZUR, 1990 and in press). EFTEKHARNEZHAD & BEHROOZI (this vol.) have assumed that the upper unit above the ophiolitic lower unit of the Fariman area belongs possibly to the Triassic. In this case the first assumption would be proven. However, no paleontologic data are present from the upper unit.
2) If the upper unit displays Permian age and the Triassic would be then missing, the ophiolitic sequence (lower unit) of the Fariman area could represent a remnant of the Hercynian or any other Late Paleozoic ocean. The final closing of this ocean would occur in this case during the highest Lower Permian or even during the Middle Permian, still a little later than in the Ural geosyncline.

This closing of an oceanic area would be contemporaneous with orogenic movements in the Circum-Pacific area (Hunter/Bowen Phase). In this time thick flysch deposits occur also in Western Sicily (Sosio Phase) and in the eastern part of the Southern Alps the marine sedimentation ended a little before the deposition of the Tarvisio Breccia. Even in the Germanic Basin distinct movements can be observed in this time (Brachwitz movements sensu HOLUB & KOZUR, 1981). Over a time span from the Upper Kungurian until lower part of Middle Permian these movements lead to distinct, nearly world-wide traceable changes in the paleogeography in connection with the Palatine phase and contemporaneous movements, e.g.: end of molasse stage and beginning platform stage in the Germanic Basin, begin of the transgression in the Southern Alps (Val Gardena basal conglomerate), deepening of the southern Permian Tethys (e. g. red deep-water clays in Sicily and transgressions on the forelands, e. g. in Tunisia), end of the Gondwana development and beginning of the Tethyan development in Kashmir and in the Salt Range.

Acknowledgement

We thank very much Dr. A.W. RUTTNER, Vienna, for yielding the samples, geologic sample data and very important discussions to the geology of the Fariman area.

Plate 1

Figs. 1,2,5,6,8: ***Mesogondolella shindyensis*** **KOZUR, n. sp.**
Fig. 1: Lower view.
150 ×.
Fig. 2: Lateral view.
150 ×.
Fig. 5: Lower view of a posterior half of a broken specimen, at several cracks broken, but secondarily grown together by mineralization along the cracks.
120 ×.
Fig. 6: Upper view of the anterior half of a broken specimen.
200 ×.
Fig. 8: Lower view of the posterior half of a broken specimen.

Figs. 3,4,7: ***Pseudohindeodus nassichuki*** **(KOZUR, 1976).**
Upper view.
150 ×.

Fig. 9: ***Pseudohindeodus*** **cf.** ***nassichuki*** **(KOZUR, 1976).**
Upper view.
200 ×.

Figs. 10,13: ***Hindeodus excavatus*** **(BEHNKEN, 1975) emend. GULLO & KOZUR, 1990.**
Lateral view.
Fig. 10: 150 ×.
Fig. 13: 300 ×.

Figs. 11,12: ***Mesogondolella gujioensis*** **(IGO, 1981).**
Juvenile specimen.
250 ×.
Fig. 11: Oblique lateral view.
Fig. 12: Lower view.

All figured conodonts are from sample P88/02, road Sang-e-Sefid – Germab, NE Sang-e-Sefid, Fariman, northern Iran, higher Lower Permian (Late Jachtashian = Late Kungurian), reddish-brown chert from a slightly metamorphic sequence of slates, pillow lavas, spilites.

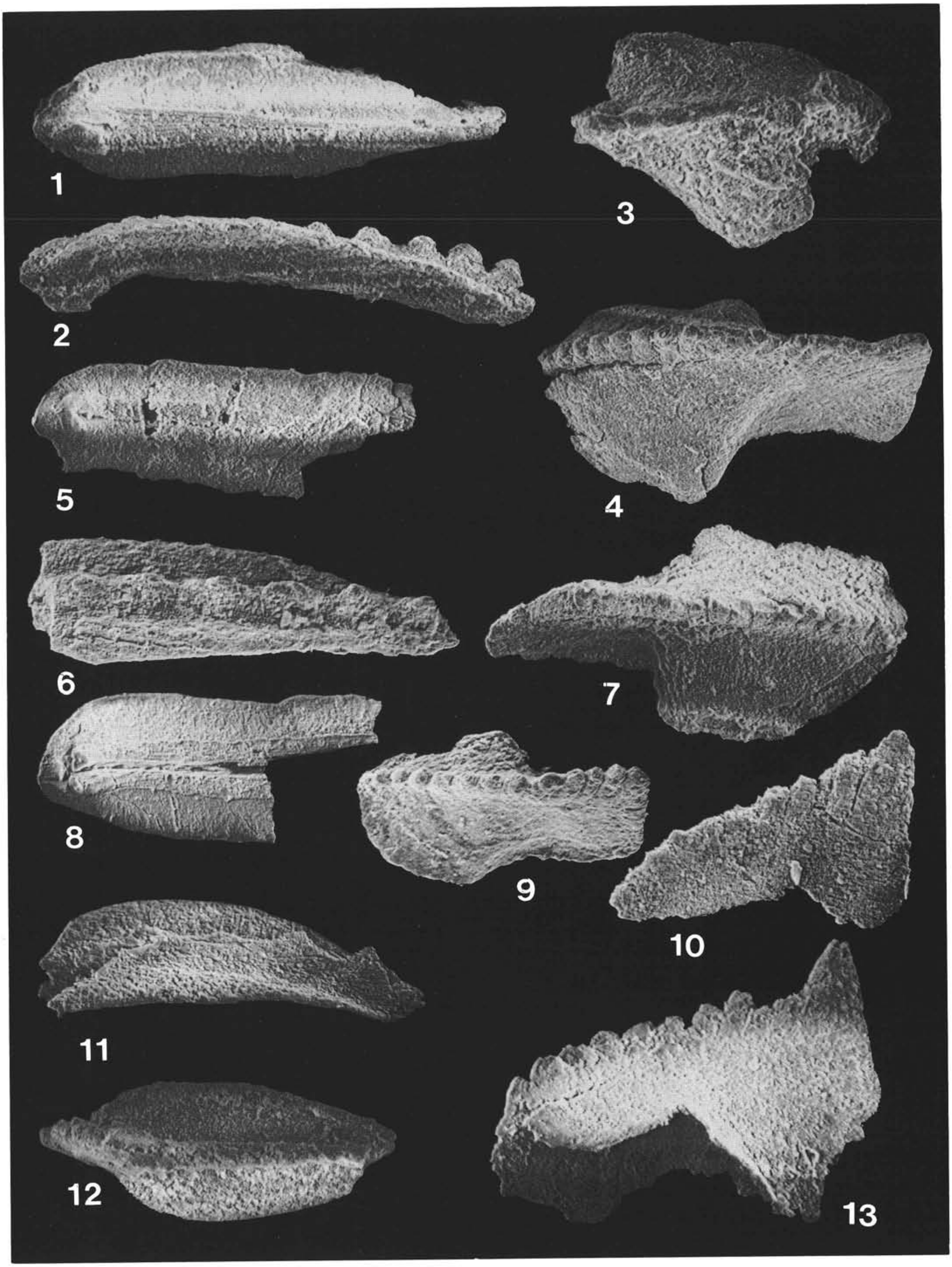

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Plate 2

Fig. 1: ***? Pseudohindeodus ? catalanoi*** **GULLO & KOZUR.**
Lateral view.
200 ×.

Fig. 2: ***Pseudohindeodus nassichuki*** **(KOZUR, 1976).**
Lateral view.
150 ×.

Figs. 3,4,9: ***Indeterminable conodonts.***
Fig. 3: 300 ×.
Fig. 4: 250 ×.
Fig. 9: Probably broken part of *Pseudohindeodus* sp..
350 ×.

Fig. 5: ***Pseudohindeodus*** **sp..**
Upper view.
150 ×.

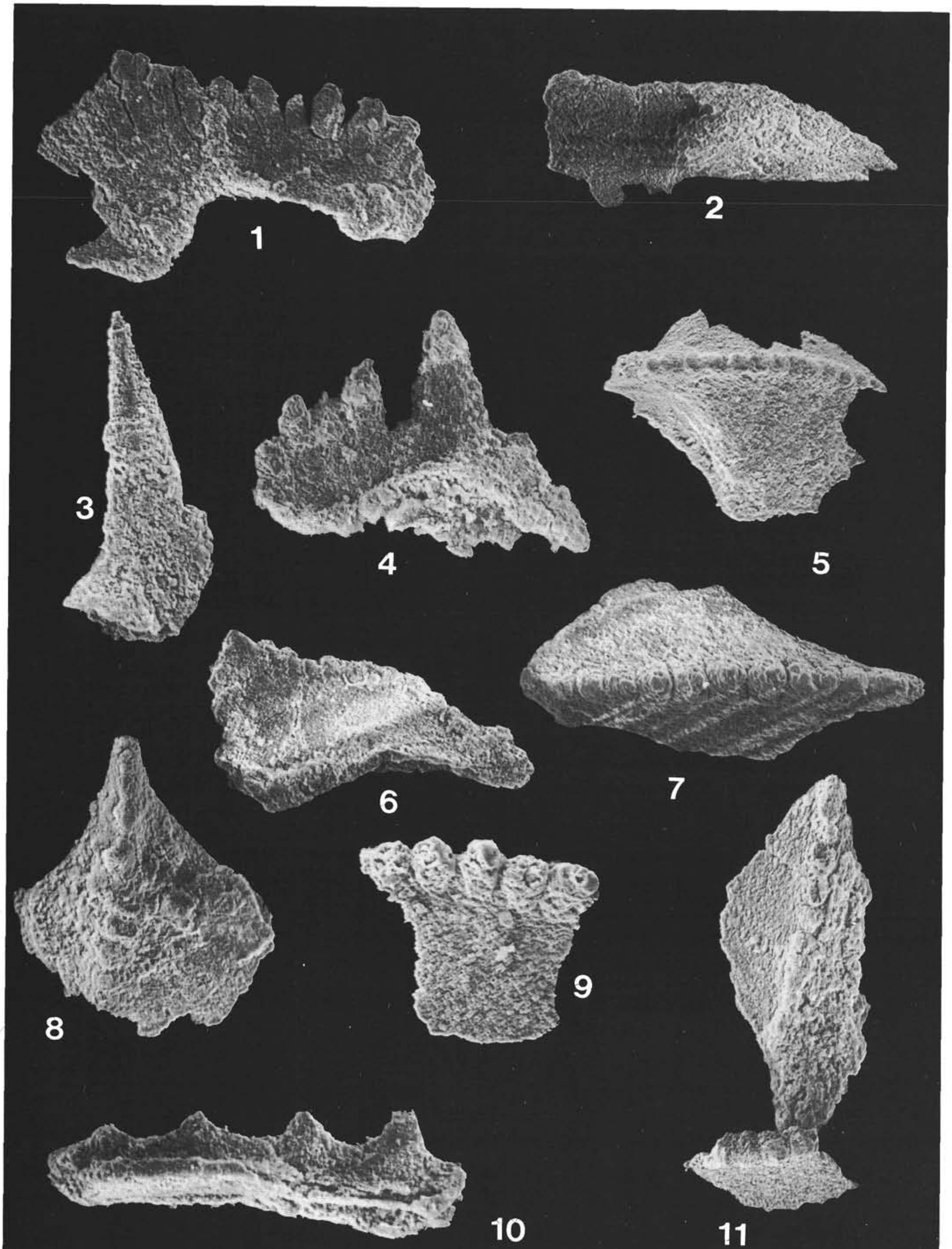
Fig. 6: ***Hindeodus excavatus*** **(BEHNKEN, 1975) emend. GULLO & KOZUR, 1990.**
Lateral view of spathognathodiform element.
150 ×.

Figs. 7,8: ***Pseudohindeodus?*** **sp..**
Upper view.
Fig. 7: 250 ×.
Fig. 8: Damaged specimen, posterior part of cup missing.
150 ×.

Fig. 10: ***Mesogondolella*** **sp..**
Lateral view of very fragmentary specimen (only anterior part preserved).
350 ×.

Fig.s 11: **2 Conodont fragments, probably of *Pseudohindeodus* sp..**
Upper view.
200 ×.

All figured conodonts are from sample P88/02, road Sang-e-Sefid – Germab, NE Sang-e-Sefid, Fariman, northern Iran, higher Lower Permian (Late Jachtashian = Late Kungurian), reddish-brown chert from a slightly metamorphic sequence of slates, pillow lavas, spilites.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